CLAIMS

Sub A1

1. A method for producing semiconductor integrated circuits, comprising the steps of:

a first step of selectively etching a metallic film formed on a surface of a substrate and exposed through a mask by using a gaseous etchant containing chlorine, bromine, or a compound thereof after the metallic film is selectively covered with the mask made of a resist; and

a second step of removing the mask used in said etching by ashing it by using a plasma generated in an atmosphere containing oxygen gas and water vapor, and removing chlorine, bromine, or a compound thereof, which are components of said gaseous etchant which remains on the surface of said metallic film exposed as a result of the removal of said mask, by forcing it to be released from said substrate.

2. The method according to claim 1, wherein said metallic film is composed of aluminum or an alloy thereof.

3. The method according to claim 2, wherein a barrier layer for blocking a reaction between said metallic film and said substrate is provided between the metallic film and the substrate.

4. The method according to claim 1, wherein said substrate is maintained at a temperature of between 100° and 250°C in said second step.

5. The method according to claim 1, wherein, in said second step, said mask and said metallic film exposed as the result of the removal of said mask are exposed to neutral active species extracted from said plasma.

6. The method according to claim 1, wherein, in said second step, said mask and said metallic film exposed as the result of the removal of said mask are exposed to said plasma.

A1 Cont'd

7. A method for producing semiconductor integrated circuits, comprising the steps of:

a first step of selectively etching a metallic film formed on a surface of a substrate and exposed through a mask by using a gaseous etchant containing chlorine, bromine, or a compound thereof after the metallic film is selectively covered with the mask made of a resist; and

a second step of removing the mask used in said etching by ashing it by exposing it to neutral active species extracted from the plasma generated in the first atmosphere, after a plasma is generated separately in both a first atmosphere containing oxygen gas and a second atmosphere containing water vapor, and removing chlorine, bromine, or a compound thereof, which are components of said residual etchant on the surface of said metallic film exposed as the result of the removal of said mask by exposing it to at least neutral active species in the plasma generated in the second atmosphere and by forcing it to be released from said

substrate.

8. The method according to claim 7, wherein said metallic film is composed of aluminum or an alloy thereof.

9. The method according to claim 8, wherein a barrier layer for blocking the reaction between said metallic film and said substrate is provided between the metallic film and the substrate.

A1 Cont'd

10. The method according to claim 7, wherein said substrate is maintained at a temperature of between 100° and 250°C in said second step.

11. A method for producing semiconductor integrated circuits, comprising the steps of:

a first step of selectively etching a metallic film exposed through a mask by using a gaseous etchant containing chlorine, bromine, or a compound thereof after the metallic film formed on a surface of a substrate is selectively covered with the mask made of a resist; and

a second step of removing the mask used in said etching by ashing it by using a first plasma generated in an atmosphere containing oxygen gas; and

a third step of removing chlorine, bromine, or a compound thereof, which are components of said residual etchant on the surface of said metallic film exposed as the result of the removal of said mask by forcing it to be released from said substrate by using a second plasma generated in an atmosphere containing water vapor.

12. The method according to claim 11, wherein said second and third processes are performed by using the same apparatus.

13. The method according to claim 11, wherein said second and third processes are performed by using a different apparatus for each process.

14. The method according to claim 13, wherein the apparatus used in said third process is of a downflow type.

15. The method according to claim 11, wherein said metallic film is composed of aluminum or an alloy thereof.

16. The method according to claim 11, wherein a barrier layer for blocking the reaction between said metallic film and said substrate is provided between the metallic film and the substrate.

17. The method according to claim 11, wherein said substrate is maintained at a temperature of between 100° and 250°C in said second step.

18. The method according to claim 11, wherein said metallic film is exposed to neutral active species extracted from the second plasma in the third process.

19. The method according to claim 11, wherein said metallic film is exposed to said second plasma in the third process.

20. An apparatus for producing semiconductor integrated circuits, comprising:

an etching chamber for selectively etching a metallic

film formed on a substrate and covered with a mask formed of a resist by using a gaseous etchant containing chlorine, bromine, or a compound thereof;

an ashing chamber for ashing said mask formed on said substrate and connected, through a first load lock chamber which is capable of making a vacuum, to said etching chamber and sent from said etching chamber by using a plasma generated in an atmosphere containing oxygen gas so as to remove it; and

an after-treatment chamber for removing residual chlorine, bromine, or a compound thereof on the surface of said metallic film on said substrate connected to said etching chamber through a first load lock chamber which is capable of making a vacuum and sent from said etching chamber by using a plasma generated in an atmosphere containing water vapor.

21. The apparatus according to claim 20, wherein said after-treatment chamber comprises:

a plasma generating section into which gas containing water vapor is introduced and into which a plasma generating means for generating a plasma in said gas is connected; and

a treatment section which is connected to said plasma generating section, these said sections being divided from each other by a division wall in which small openings through which neutral active species in a plasma pass are provided, and in which said substrate is placed.

22. The apparatus according to claim 20, wherein gas containing water vapor is introduced into said after-treatment chamber, said substrate is placed therein, and said after-treatment chamber has parallel flat-plate type electrodes disposed on both sides of said substrate with said substrate as a center thereof.